

The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board.

Paper No. 23

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte GREGORY L. BIGGS,
TRACEY M. BLACKMER, TANVIR H. DEMETRIADES-SHAH,
KYLE H. HOLLAND, JAMES S. SCHEPERS,
and JOHN HENRY WURM

Appeal No. 1999-1101
Application 08/727,125¹

ON BRIEF

Before BARRETT, DIXON, and BLANKENSHIP, Administrative Patent Judges.

BARRETT, Administrative Patent Judge.

DECISION ON APPEAL

¹ Application for patent filed October 8, 1996, entitled "Method and Apparatus for Real-Time Determination and Application of Nitrogen Fertilizer Using Rapid, Non-Destructive Crop Canopy Measurements," which is a continuation-in-part of Application 08/410,783, filed March 24, 1995, now abandoned.

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This is a decision on appeal under 35 U.S.C. § 134 from the final rejection of claims 1-4, 6, 7, 9, 10, 12, 13, and 17-21. Claims 5, 8, 11, 14, 22, and 23 stand allowed. In the examiner's answer (Paper No. 22), page 2, claim 14 is allowed and claims 15 and 16 are noted to contain allowable subject matter.

We affirm.

BACKGROUND

The invention relates to a method and apparatus for the real-time determination and application of optimum amounts of fertilizer to a crop. A physical attribute related to the fertilizer requirement of the crop is sensed and used to control the fertilizer application. The fertilizer application may be controlled by comparing a sensed physical characteristic of a reference area of the crop that is known to have sufficient fertilizer with a non-reference area of the crop.

Claim 1 is reproduced below.

1. A method for controlling the application of fertilizer to a crop having a physical attribute related to the fertilizer requirement of said crop, comprising the steps of:

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- (a) providing a sensor which is responsive to at least one characteristic of said crop;
- (b) measuring said at least one characteristic of said crop;
- (c) determining at least one physical attribute of said crop from said measurement of a characteristic; and
- (d) controlling fertilizer application to said crop in real-time in response to said physical attribute.

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THE PRIOR ART

The Examiner relies on following references:

Wolfe, Jr.	4,662,563	May 5, 1987
Monson	5,355,815	October 18, 1994

Todd A. Peterson, Tracy M. Blackmer, Dennis D. Francis, and James S. Schepers, Using a Chlorophyll Meter to Improve N Management, NebGuide G93-1171-A, published by Cooperative Extension, Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln, July 1993 (hereinafter "Peterson").

T.H. Demetriades-Shah and M.N. Court, Oblique view reflectance for assessing nitrogen status of incomplete canopies, Int. J. Remote Sensing, 1987, Vol. 8, No. 7, pp. 1049-1055 (hereinafter "Demetriades-Shah").

Wolfe discloses a center pivot irrigation system with a controller for automatically starting and stopping the irrigation system based on the sensed moisture level of the soil (abstract).

Monson discloses a real-time (on-line) system for controlling fertilizer application from a tractor. The system includes a soil analyzer 28 capable of analyzing soil for chemical content (e.g., nitrogen, phosphorus, and potassium) and soil type (e.g., clay, sand, or silt) in real time and an expert system 30 that determines a soil prescription and instructs control application system 22 to dispense a blend of

fertilizers at a rate depending upon the determined soil chemical composition. Monson does not disclose real-time application of fertilizer based on a physical characteristic of the crop.

Peterson discloses use of a hand-held chlorophyll meter to measure portions of leaves in the field as a tool to detecting nitrogen deficiency and determining the need for additional nitrogen fertilizer. The meter is an alternative to soil testing (first page). Peterson discloses that there is a close link between leaf chlorophyll and nitrogen content (first page). Peterson teaches using reference strips (strips in the field that are adequately fertilized with sufficient levels of nitrogen fertilizer so they do not exhibit nitrogen deficiency) to calibrate the chlorophyll meter for each field, previous crop, hybrid, fertilizer and/or manure application, and differing soil types (under "Establishing Reference Strips" and Fig. 3). "By comparing the average chlorophyll meter readings from the reference strips to those from the rest of the field, N sufficiency and the need for additional N supplied through fertigation can be determined." (Under "Establishing Reference Strips.") The recommended measurement

technique compares meter readings from the reference strip and the bulk field at a minimum of three locations in each field and, at each location, the average reading of 30 plants from the reference area and the adjacent bulk field should be compared (under "How to sample"). Because chlorophyll meter readings vary with the time of day, readings from the reference strip and the bulk field should be taken at about the same time (id.). Peterson forecasts that "[p]otential uses of these techniques in the future may include remote sensing by satellite or airplane to schedule the need for additional fertilizer N" (under "The chlorophyll meter as an N management tool").

Demetriades-Shah discloses an experiment to determine if a change in crop color due to nitrogen stress (lack of nitrogen) can be assessed in terms of leaf chlorophyll concentrations using crop reflectance measurements. Demetriades-Shah discloses that "leaf chlorophyll concentration assessed on a plant weight basis is strongly influenced by the nutrient status of the soil and by the growth stage of the crop, rising after germination and then declining as crop growth rate increases" (pp. 1049-50).

Demetriades-Shah compares measurements of crop reflectances taken from a conventional nadir view (vertically downward looking) against reflectances taken at an oblique angle. Canopy reflectance from a downward view includes the influence of soil visible between the plants and is primarily sensitive to the relative amounts of soil and green vegetation in its field of view rather than the greenness of canopy leaves (p. 1055). There is a strong correlation between reflectance measurements and chlorophyll content per unit ground area, but poor correlation between reflectance measurements and chlorophyll per unit plant weight for downward-looking measurements (p. 1051). Demetriades-Shah concludes "that plant chlorophyll concentration is better predicted from oblique-looking reflectance measurements than from vertically downward-looking measurements, because the influence of soil reflectance is removed" (p. 1055).

THE REJECTIONS

Claims 1, 3, 7, 9, 13, and 17-21 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Monson, Demetriades-Shah, and Peterson.

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Claims 2, 4, 6, 10, and 12 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Monson, Demetriades-Shah, and Peterson, further in view of Wolfe.²

We refer to the final rejection (Paper No. 12) and the examiner's answer (Paper No. 22) for a statement of the Examiner's position, and to the appeal brief (Paper No. 21) (pages referred to as "Br__") for a statement of Appellants' arguments thereagainst.

OPINION

Claim 1

The test for obviousness is what the combined teachings of the references would have suggested to those of ordinary skill in the art. In re Keller, 642 F.2d 413, 425, 208 USPQ 871, 881 (CCPA 1981). Monson discloses a "real-time" fertilization system in which fertilizer is dispensed in real time in response to the measured composition of the soil. "Real time" is interpreted to mean that the fertilizer is applied at a certain location at approximately at the same time as the measured need for fertilizer at that location.

² The statement of the rejection in the examiner's answer, page 4, incorrectly includes allowed claim 11.

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The difference between Monson and the subject matter of claim 1 is that Monson measures physical characteristics of the soil, not a characteristic of the crop, as claimed. Peterson teaches the claimed subject matter of independent method claims 1 and 3 except for controlling fertilizer application "in real-time." The hand-held chlorophyll meter in Peterson is not suitable for a continuous real-time (on-line) fertilizer application method or apparatus and, so, would not constitute the "means for measuring" of claim 9. Peterson discloses that the hand-held chlorophyll meter for measuring a crop characteristic (the chlorophyll content) is a substitute for soil analysis (first page); thus, Peterson suggested measuring the physical characteristics of a crop, instead of the soil as in Monson, to determine fertilizer requirements. Peterson further discloses that future techniques would include remote sensing by satellite or airplane in place of the hand-held meter (under "The chlorophyll meter as an N management tool"); thus, Peterson suggested using remote sensing of crop physical characteristics in place of the hand-held meter and in place of soil analysis. Demetriades-Shah teaches remote sensing of

chlorophyll concentration by reflectance measurements and that chlorophyll concentration is directly related to nitrogen fertilizer requirements of the crop. One of ordinary skill in the art would have been motivated to substitute a reflectance measurement sensor, either vertically or obliquely mounted, as taught in Demetriades-Shah for the soil measurement sensor in the real-time system of Monson because: (1) it was a known alternative way to determine fertilizer requirements; (2) Peterson suggested remote sensing in place of soil testing to determine fertilizer requirements and Demetriades-Shah was one known type of remote sensor for determining fertilizer requirements; and (3) there is a direct correlation between the measured chlorophyll (nitrogen) content of the crop and the fertilization requirements of the crop in Demetriades-Shah and Peterson, whereas there is only an indirect correlation between the nitrogen content of the soil and the fertilization requirements of the crop in Monson. In the absence of persuasive arguments to the contrary, the combination of references is sufficient to establish a prima facie case of obviousness.

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Next, we determine whether Appellants' arguments demonstrate insufficient evidence of prima facie obviousness. See In re Rouffet, 149 F.3d 1350, 1355, 47 USPQ2d 1453, 1455 (Fed. Cir. 1998) ("On appeal to the Board, an applicant can overcome a rejection by showing insufficient evidence of prima facie obviousness or by rebutting the prima facie case with evidence of secondary indicia of nonobviousness.").

Our discussion of the claims is limited to the arguments in the brief. Under U.S. Patent and Trademark Office rules, Appellants' brief is required to specify the particular limitations in the rejected claims which are not described in the prior art or rendered obvious over the prior art. See 37 CFR § 1.192(c)(8)(iv) (1997). Cf. In re Baxter Travenol Labs., 952 F.2d 388, 391, 21 USPQ2d 1281, 1285 (Fed. Cir. 1991) ("It is not the function of this court to examine the claims in greater detail than argued by an appellant, looking for nonobvious distinctions over the prior art."); In re Wiechert, 370 F.2d 927, 936, 152 USPQ 247, 254 (CCPA 1967) ("This court has uniformly followed the sound rule that an issue raised below which is not argued in this court, even if it has been properly brought here by a reason of appeal, is

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regarded as abandoned and will not be considered. It is our function as a court to decide disputed issues, not to create them."); In re Wiseman, 596 F.2d 1019, 1022, 201 USPQ 658, 661 (CCPA 1979) (arguments must first be presented to the Board before they can be argued on appeal).

Appellants argue that Monson senses the characteristics of the earth and is not concerned with measuring characteristics of plants. It is argued that Monson apparently does not appreciate that soil measurements cannot accommodate the different amounts of nitrogen needed at different times of the year and under different environmental conditions (Br14-15; Br15-16).

One cannot show nonobviousness by attacking the references individually where the rejection is based on a combination of references. Keller, 642 F.2d at 426, 208 USPQ at 882. While it is true that Monson only teaches sensing soil characteristics, it is Demetriades-Shah and Peterson that are relied on to show measurement of a physical characteristic of a crop.

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Appellants argue that Demetriades-Shah does not suggest using radiation and sensing of reflection in an on-line system such as that taught by Monson even in view of Peterson (Br15).

Demetriades-Shah teaches measurement of a characteristic of the crop, its reflectance, which characteristic is directly related to chlorophyll concentration, which, in turn, is directly related to nitrogen requirements of the crop. One of ordinary skill in the sensing art would have had sufficient skill to appreciate that the reflectance measurements and calculations in Demetriades-Shah can be done in real time because they are similar in nature to the spectrographic analysis in Monson, unlike the hand-held meter in Peterson and unlike chemical assaying of plant nitrogen status. One of ordinary skill in the art would have been motivated to apply remote sensing in a real-time fertilization system in view of Monson. Demetriades-Shah and Peterson provide the motivation to use remote sensing of physical characteristics of the crop, instead of the soil, to determine fertilizer requirements.

Appellants argue that "Demetriades-Shah, et al., teaches away from the necessary reflectance measurement in which the light is reflected down and then upwardly by referring to

oblique measurements to avoid interference with background" (Br15). It is also argued that "[t]he oblique measurement system of Demetriades-Shah, et al., requires separated sources of light and detector devices not indicative of the current system" (Br16).

None of the claims on appeal recite a specific sensor, much less a sensor that uses downward radiation and reflection of upward waves. Nor do the claims recite measuring a specific characteristic which might indirectly limit the type of sensor; e.g., measurement of plant biomass (also called crop density or fractional cover), the relative amounts of soil and green vegetation within view of the sensor, is measured by a downward-looking sensor (specification, pp. 3-4; Demetriades-Shah, p. 1049). The claims only require a sensor that measures a characteristic (claim 1) or a physical characteristic (claims 3 and 9) of the crop. Demetriades-Shah describes a comparison between radiometer sensors that are oriented looking vertically down and that are oriented at an oblique angle (p. 1050) and, thus, teaches both kinds of measurement. Each type of orientation is good for a certain purpose. A reference must be evaluated for all it fairly

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suggests to one of ordinary skill in the art. In re Boe, 355 F.2d 961, 965, 148 USPQ 507, 510 (CCPA 1966); In re Lemelson, 397 F.2d 1006, 1009, 158 USPQ 275, 277 (CCPA 1968) (the use of patents as references is not limited to what the patentees describe as their own invention or to the problems with which they are concerned). Appellants' argument that the measurement system of Demetriades-Shah is not indicative of the current system is not commensurate in scope with the claim language.

It is argued that Peterson teaches a hand measuring device which cannot perform a continuous on-line measurement (Br15) and Peterson's leaf-by-leaf measurement has no utility to the invention (Br16).

It is true that the chlorophyll meter of Peterson is not suited to a real-time system. However, Demetriades-Shah is relied on for a suitable sensor. Again, one cannot show nonobviousness by attacking the references individually where the rejection is based on a combination of references.

Keller, 642 F.2d at 426, 208 USPQ at 882. It is noted that Peterson expressly suggests that the chlorophyll (nitrogen) measurement could be done by remote sensing instead of a

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hand-held meter (under "The chlorophyll meter as an N management tool").

We conclude that Appellants have not demonstrated error in the prima facie case of obviousness. The rejection of claim 1 is sustained.

Claims 17-21

Claim 17 depends on claim 1 and recites that the sensed characteristic is electromagnetic radiation affected by the crop. Appellants argue that the limitation defines a further invention (Br17). However, Demetriades-Shah discloses sensing electromagnetic radiation affected by the crop and this teaching has not been addressed by Appellants. It is also noted that Peterson discloses that remote sensing by satellite or aircraft could be used to determine nitrogen content, which implies sensing electromagnetic radiation affected by the crop. The rejection of claim 17 is sustained.

Claim 18 depends on claim 1 and recites that the step of determining the physical attribute includes the substep of comparing the sensed characteristic with a reference value. Appellants argue that while Peterson discloses the use of a reference crop, it does not teach any mechanism by which

moving measuring devices can sense both a reference crop and the crop that is to be determined simultaneously (Br17). Peterson teaches comparing readings from a bulk field with a reference strip (under "Establishing Reference Strips") and that readings should be taken from the reference strip and the bulk field at about the same time because readings may vary with time of day (under "How to sample"), which suggests comparing reference and non-reference readings taken more or less simultaneously. One of ordinary skill in the art would have been motivated to provide for simultaneous measurement of reference and non-reference in implementing a real-time system. However, it is noted that neither claim 18 nor any of the other claims require simultaneous sensing of a reference and a non-reference value: the value of the reference crop could be measured and stored for comparison and use during the time the non-reference crop is being measured. The rejection of claim 18 is sustained.

Claim 19 depends on claim 18 and recites that the reference value changes in accordance with a changing standard for a crop. Appellants argue that this allows different environmental conditions or growing stages of the crop to be

taken into consideration, but do not address the teachings of the references (Br17). Peterson discloses that the measured value of chlorophyll (and, hence, the amount of nitrogen in the plant) for an adequately fertilized crop in the reference strips (the standard for a crop) changes in response to crop and environmental conditions which is the reason for reference strips to calibrate the bulk field readings (paragraph above "Field Use of the Chlorophyll Meter" and under "Establishing Reference Strips"). Thus, Peterson teaches that the reference value changes in accordance with a changing standard for the crop. The rejection of claim 19 is sustained.

Claim 20 depends on claim 19 and recites that the changing standard is electromagnetic radiation affected by a reference crop in the same stage of growth. Appellants argue that this requires that electromagnetic radiation must be affected by different stages of growth, but do not address the teachings of the references (Br17). Peterson discloses that the amount of measured chlorophyll (hence, the amount of nitrogen in the plant) is affected by environmental conditions and discloses the use of reference strips of crops in the same stage of growth as a changing standard for chlorophyll

measurement. One of ordinary skill in the art would have been motivated to measure electromagnetic radiation to remotely sense the amount of chlorophyll in view of Demetriades-Shah. The rejection of claim 20 is sustained.

Claim 21 depends on claim 19 and recites that the changing standard includes a changing background reflection. Appellants argue that there is no contemplation in the references in dealing with the difficulty of background reflections which are strong and disturbing in making the measurements (Br18). We do not find any disclosure in the specification about what is meant by "a changing background reflection." If background reflection is intended to refer to soil reflection, which changes as the crop biomass (fractional cover) increases, then Demetriades-Shah discloses that vertically downward-looking measurements can be used to provide a good correlation between crop growth and chlorophyll per unit ground area (pp. 1051, 1055). Demetriades-Shah teaches that either a vertically downward-looking or oblique-looking sensor can be used; each provides correlation to a different characteristics of the crop. In any case, since "the changing standard includes a changing background

reflection" appears to be a property of the crop, the reference crop in Peterson inherently has this property. The rejection of claim 21 is sustained.

Claims 3, 7, 9, and 13

Independent method claim 3 recites a crop having a non-reference area and a reference area, measuring the physical characteristics of the reference crop and non-reference crop, and controlling fertilizer application in real time based on a comparison of the reference and non-reference crop physical characteristics. Independent apparatus claim 9 contains corresponding means-plus-function limitations. Thus, claims 3 and 9 differ from claim 1 in requiring the comparison of physical characteristics of a reference crop.

Appellants rely on the same arguments as made with respect to claim 1 (Br18). We refer to our discussion of claim 1 for a response to these arguments. Appellants do not argue the reference crop limitations. Nevertheless, Peterson expressly discloses that the need for additional nitrogen should be determined by comparing readings of reference strips of crop and non-reference areas of the crop (the bulk field)

because the standard chlorophyll readings (hence, the amount of nitrogen in the plant) are affected by many factors. One of ordinary skill in the art would have been motivated by Peterson to use reference areas of crop to calibrate the sensors regardless of the type of sensor. It is noted that claims 3 and 9 do not require that the physical characteristics of the reference crop and the non-reference crop be determined simultaneously. The physical characteristic of the reference crop could be measured and stored and then used for comparison during measurement of the physical characteristics of the non-reference crop (the bulk field). The rejection of claims 3 and 9 is sustained.

As to claim 7, Appellants merely repeat the limitations of the claim. This is not an argument. See 37 CFR § 1.192(c)(7). In any case, however, Monson expressly teaches that the sensor can be secured to a tractor drawn real-time fertilizer application system. One of ordinary skill in the art seeking to use an electromagnetic sensor as taught by Demetriades-Shah in a real-time fertilization system would have been motivated to mount the sensor on a tractor in view of Monson. Claim 13 is the apparatus counterpart of claim 7

and would have been obvious for the same reason. The rejection of claims 7 and 13 is sustained.

Claims 2, 4, 6, 10, and 12

Claims 2, 4, and 10 recite measuring by passing the sensor over the crop by securement to a center pivot irrigation system. Claim 4 also recites that the fertilizer application is by fertigation.

Appellants argue that claim 2 depends from claim 1 and is patentable for the same reasons as claim 1 (Br19), that claim 4 depends from claim 3 and is patentable for the same reasons as claim 3 (Br20), and that claim 10 depends from claim 9 and is patentable for the same reasons as claim 9 (Br21). We disagree that claims 1, 3, and 9 are patentable for the reasons stated in the discussion of those claims.

Appellants argue that it would have been unobvious to combine Wolfe with Monson and Demetriades-Shah since Wolfe senses only moisture in soil and does not relate to sensing a characteristic that reflects the attribute of a plant (Br19). Moreover, it is argued, Wolfe senses the soil in only one location and could not accommodate variation of the needs of the crop from location to location (Br20). It is argued that

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Peterson with its hand-held meter does not cure the problem and Demetriades-Shah teaches away from a solution (Br20).

Monson teaches securement of the measurement sensor to the moving irrigation device, a tractor in Monson's case, to provide a real-time irrigation system. Manifestly, for a real-time fertilization system, such as Monson, it is necessary for the sensor to travel along with the fertilization means so that the fertilizer can be applied based on the measured characteristic. Monson would have suggested to one of ordinary skill in the art to secure the sensor to the fertilization means in any real-time fertilization system. Wolfe teaches a center pivot irrigation system which could be used for fertilization (fertigation) and we agree with the Examiner that it would have been obvious to attach a measurement sensor to such a system. In addition, however, Peterson discloses applying nitrogen fertilizer through the irrigation system (fertigation) which is generally limited to center pivot or lateral move sprinkler systems (second page, first para.). Peterson discloses fertilization based on the physical characteristics of the plant and suggests the use of remote sensing instead of a hand-held

meter. We conclude that it would have been obvious to one of ordinary skill in the art to secure sensors to any mechanism for dispensing fertilizer in view of the real-time system in Monson and, in particular, it would have been obvious to secure the sensor to a center pivot fertigation system because Peterson teaches that the center pivot system was a well known mechanism for dispensing fertilizer. Further, in our opinion, one of ordinary skill in the art would have had sufficient knowledge to extend Peterson's suggestion of "remote sensing by satellite or airplane" (under "The chlorophyll meter as an N management tool") to sensors mounted on high-clearance ground equipment, such as center pivot fertigation systems. The rejection of claims 2, 4, and 10 is sustained.

Claims 6 and 12 recite that the sensor measures the light reflectances from the crop. Demetriades-Shah teaches this limitation. The rejection of claims 6 and 12 is sustained.

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CONCLUSION

The rejections of claims 1-4, 6, 7, 9, 10, 12, 13, and
17-21 are sustained.

No time period for taking any subsequent action in
connection with this appeal may be extended under 37 CFR
§ 1.136(a).

AFFIRMED

LEE E. BARRETT)	
Administrative Patent Judge)	
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)	BOARD OF PATENT
JOSEPH L. DIXON)	APPEALS
Administrative Patent Judge)	AND
)	INTERFERENCES
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Administrative Patent Judge)	

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